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Environmental Metadata Framework

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Signposts for sustainability

Environmental Metadata Framework

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Version Control

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0.1	20/01/02	Initial draft	EK
0.2	05/08/02	Restructured document with inclusion of spatial referencing, data content and data quality sections & EMF metadata profile descriptions	NP
0.3	08/08/02	Code List, ISO 19115 Metadata Extension Definitions, Bibliography and Complete Section 2	NP
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A thank you to these people and all others that have been involved in discussions, testing and thinking about what the Environmental Metadata Framework could be.

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Executive Summary

It is not simply a matter of saying here are the metadata elements that you should use to make up a profile. Aspects outside the metadata elements and standards drive the numbers and types of elements that are used to make up a profile. This document and the framework it describes are designed to take the reader through the process of choosing the most suitable suite of metadata elements for their purpose. It is tailored to the needs of the environmental and geospatial community of interest within New Zealand and has been designed to fit with the E-Government initiatives and other whole-of-government processes. The following guidelines are written to guide someone planning their first metadata implementation. The guidelines raise a number of issues and questions that should be resolved in the planning stages.

The Environmental Metadata Framework helps with the initial decisions about the most suitable suite of metadata elements. It is based around several steps that are worked through sequentially and are illustrated in Figure 1.

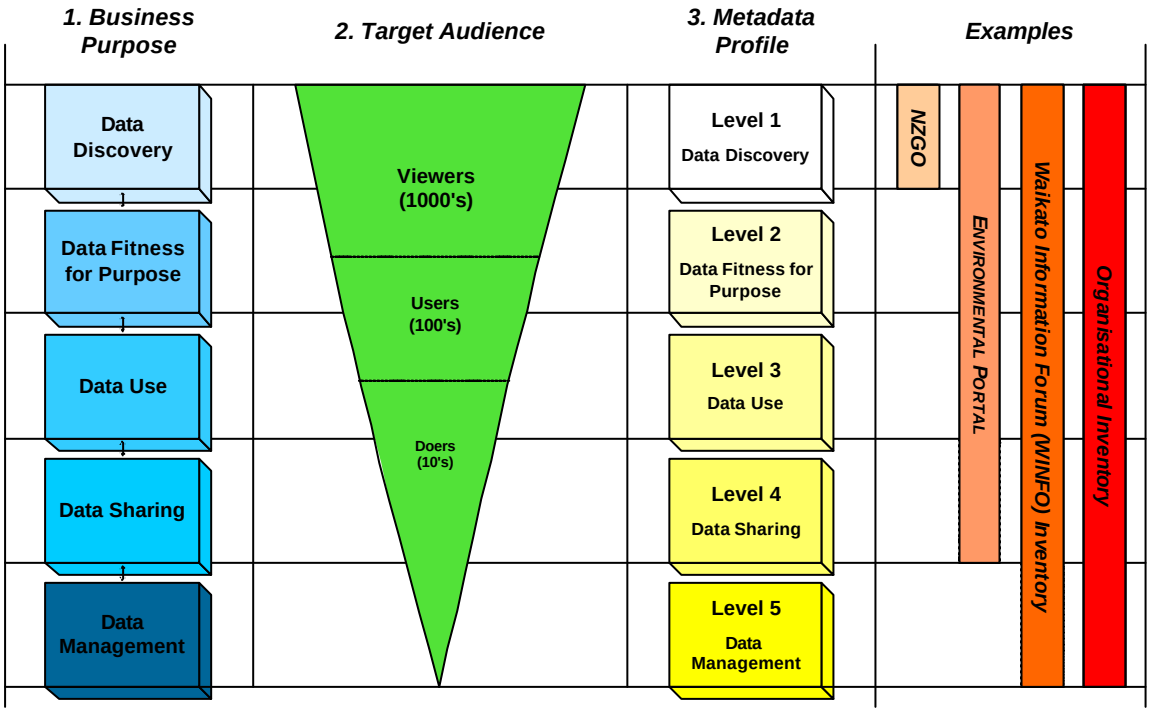
1. Decision on the business purpose for documenting metadata about an information resource.

2. Identification of the target audience, i.e. those who will use the metadata.

3. Selection of the appropriate metadata profile (based on the previous findings on business purpose and target audience).

4. Verification of the selection of metadata profile by examining the objectives of the specific project or initiative.

Figure 1 Decision support process for Environmental Metadata Framework



Once an appropriate metadata profile has been selected for an agency, there are a number of other questions need to be answered before metadata documentation can begin:

1. Does the *metadata profile* need to be customised for use in this agency?

2. Are the *spatial referencing systems* for the agency's spatial datasets compatible or are additional details needed to describe coordinate systems and coordinate transformations with these details recorded within the metadata?

3. Does a *feature catalogue* or *application schema* need to be published with the metadata (Level 4 & 5 Metadata Profiles)?

4. Does a more rigorous *data quality* regime need to be implemented to enable the data quality metadata details of Level 5 Data Management metadata profiles to be properly completed?

The use of this framework has been developed to provide a range of metadata options for agencies holding or using environmental data resources. Detailed reference material has been developed for each metadata profile and is available for download from the Environmental Reporting website, www.environment.govt.nz.

The Environmental Metadata Framework conforms to two metadata standards for the documentation of information resources:

- New Zealand Government Locator Service (NZGLS) and

- International Standards Organisation (ISO) Draft International Standard (DIS) Geographic Information - Metadata (known as ISO/DIS19115).

The information within this document pulls earlier work together and creates a framework, which provides practical guidance on how to develop metadata inventories. It draws on work done by Dr Glen Lauder (Commonground & Associates) for the Waikato Information Forum (WINFO), contributions from Neil Pullar (Cadastre Limited) and has incorporated the deliberations of the core members of the Ministry for the Environment's Metadata Reference Group.

1. Introduction

1.1 What is metadata?

Metadata are units of information about information. They are commonly used to provide descriptive information about the content, context and characteristics of data. Metadata can help to keep track of changes in data (*meta* means *change*). It can also make other potential users of the data aware of its existence and possible applications.

The most obvious example of metadata is a library catalogue system, which provides a common set of summary information for books, journals and other library resources. Metadata deals with the what, when, who and how of data. It needs to be collected at different levels of detail to satisfy different purposes.

Metadata doesn't just describe data, it tracks changes to it. In a networked environment, information may gain value as it changes hands but only if the current holder knows this history. Metadata maintains the value of data for both the creator and the subsequent users by assuring it continued use.

Geospatial metadata

Geospatial metadata incorporates the additional element of where. A map legend is a common example of spatial metadata. It provides information about the publisher and publication date, scale, accuracy, datum and other characteristics of the map. Metadata is also commonly used at the level of a series of printed maps. In a similar way, metadata is also applied to digital spatial data at the levels of datasets, individual dataset series, tiles of datasets, even down to the feature level.

Geospatial metadata discovery tools enable the searcher to find information through a spatial (map) interface rather than by using a text search alone.

1.2 Costs and benefits of metadata

Costs

Creating and managing metadata does involve significant effort and hence introduces additional costs to managing an information resource. The information needed to create metadata is often readily available when the data is collected. If the people who understand the data produce metadata at the same time as the data, costs can be reduced.

Weighing the initial expense of documenting data against the potential costs of duplicated or redundant data generation will determine whether the documentation of metadata is justified. In general, investing time and resources at the beginning of a new project will pay dividends.

Benefits

Metadata produces benefits for both producers and users of data. These are outlined below:

- **Information investment management:** Metadata helps organise and maintain an organisation's investment in data and provides information about an organisation's data holdings in catalogue form.

- **Greater information efficiency:** Coordinated metadata development avoids duplication of effort by ensuring the organisation is aware of the existence of data sets.

- **Complete information:** Users can locate all available data relevant to an area of interest.

- **Better information practice:** Collection of metadata reinforces good data management practices and ensures the long-term value of the investment in data creation and collection.

- **Information promotion:** Data providers are able to advertise and promote the availability of their data and potentially link to on-line services (e.g. E-government) that relate to their specific datasets. Reporting of descriptive metadata also promotes the availability of environmental data beyond the environmental community.

- **Knowledge management:** Metadata is an important knowledge management tool preserving understanding and preventing data from losing its value through personnel change in an organisation.

- **Greater information longevity:** Metadata maintains the value of data for the creator by assuring its continued use and update over time.

1.3 Metadata Standards

A metadata standard is simply a common set of terms and definitions known as elements that describe an information resource. Consistency in metadata is essential to ensure meaningful comparisons can be made quickly between datasets. Without standardisation of metadata, finding common elements in descriptions can be very difficult as it involves getting to grips with a range of different metadata management formats and definitions.

A metadata standard also allows for quick search and retrieval of a particular element. Using a consistent name for an element and a consistent meaning or level of information makes the process much easier.

Standards provide a common set of elements while allowing for additional elements to be produced to suit specialist needs. They are developed through a consultative process between experts and must be comprehensive enough that they can provide a sufficient level of detail, clarity and accuracy for users.

1.4 Metadata Profiles

A metadata profile will use a selection of some or all of the metadata elements within a metadata standard to meet the needs of a community of interest or a specific purpose. The same reasons exist for using a standardised profile for a particular inventory as for using a metadata standard.

In the case of the metadata profiles defined as part of the Environmental Metadata Framework, the base standards are ISO/DIS 19115 (Geographic Information – Metadata) and the New Zealand Geographic Locator Service (NZGLS). The function is environmental information management in New Zealand.

The choice of which clauses, classes, options and parameters are chosen and included in each of the metadata profiles involve the following decisions:

1. To include all metadata elements identified as core elements in ISO/DIS 19115 (a requirement for any metadata profile claiming conformance with ISO/DIS 19115) – 22 elements.

2. To exclude any elements identified in ISO/DIS 19115 as optional unless required as a mandatory or conditional metadata element.

3. To add a metadata extension to record the relevant Environmental Performance Indicator strand for each dataset where EMF metadata is produced.

4. To add a metadata extension to allow the NZGLS Mandate element to be unambiguously recorded within the ISO/DIS 19115 structures.

5. To add a number of metadata extensions to allow certain elements that is well defined in New Zealand to be included as code lists to encourage consistency in use within the metadata (eg, NZ coordinate systems, New Zealand height datums, SONZ, FONZ and ANZLIC defined keywords, NZGLS defined categories of audience).

1.5 ISO 19115 Structure

ISO/DIS 19115 is the more comprehensive (and complex) of the two base standards and so the structure of these metadata profiles is based on ISO/DIS 19115. The relationship of these metadata profiles with NZGLS is by way of tables showing the mapping of metadata elements to equivalent NZGLS elements.

ISO/DIS 19115 consists of over 400 metadata elements. These elements include repeatable series of elements and also provides for metadata extension elements to be added to cover extra characteristics considered important for a particular function. All this adds up to an extremely complex structure that cannot be described easily in a series of tables. This is not necessarily a failure of ISO/DIS 19115. The effort required to master ISO/DIS 19115 is considered worthwhile. It is exceedingly comprehensive and flexible and its adoption internationally seems assured.

To deal with this complexity and to ensure unambiguous definitions, the ISO Technical Committee for Geographic Information (ISO/TC211) has decided to use a form of data modelling called UML (Unified Modelling Language) as the authoritative definition of ISO/DIS 19115 and other geographic information standards. To demonstrate the conformance of these metadata profiles with ISO/DIS 19115 a set of UML Class Diagrams have been included in the Reference Manuals. As users' understanding of the metadata profiles increase, it is hoped the UML diagrams will offer valuable shorthand and a useful tool when considering migration to a more comprehensive metadata profile (like Level 4 or 5) or for designing metadata extensions to meet their own specific requirements.

1.6 Environmental Reporting Programme

The Environmental Metadata Framework has been developed as part of the Environmental Reporting Programme of the Ministry for the Environment. This programme has developed a suite of national environmental performance indicators to facilitate information sharing between agencies that collect and manage environmental information.

The aim of the programme is to enable better decision-making, to monitor and report on environmental trends, and to improve understanding of the environment. For this to happen all the agencies involved at local, regional and national levels need to make an increased effort to work together to make available reliable, good quality environmental information in a timely manner to support active environmental management in the future.

The Environmental Metadata Framework has been developed through the recognition that to improve awareness and access to environmental data and information the use of metadata in a consistent manner is critical. The metadata is seen as providing an entry point to environmental data and information by it being published through a linked internet-based New Zealand inventory. The Environmental Metadata Framework is the first step to creating this inventory. The fundamental approach taken is to be scalable and to exclude other related whole-of-government initiatives to create synergies by using the same core standards.

2. Environmental Metadata Framework

The Environmental Metadata Framework is a decision support tool. It may be used in a number of ways to support work with metadata that describe environmental and geospatial information resources. In the first instance, it may determine what is the appropriate metadata profile to adopt as the metadata standard for an organisation. Subsequently, it may be used to determine whether one of the other metadata profiles is more appropriate for a particular project or specific information resource.

Whatever the situation, the reasons for referring to the Environmental Metadata Framework will determine which sections need to be referred to. A number of reference documents have been produced to complement the framework. There is reference material for each of the defined metadata profiles, which includes detailed guidance on how to complete each metadata element consistently (at this time of publication only the Discovery Level profile has detailed guidance). These reference manuals are large and for this reason are only available on the Environmental Reporting website, www.environment.govt.nz for downloading based on the users requirements. Their location on the website means they can be updated when appropriate so they remain timely, authoritative reference sources.

Guidelines for Using the Framework

- Initially it is important to work through the framework process from start to finish to select the most appropriate metadata profile. Note that the verification stage of the process may result in a change in metadata profile from the one initially selected.

- Where the metadata for an information resource is likely to be referred to in more than one situation, the decision of which metadata profile should be determined by the most demanding and detailed business purpose and target audience. It is always possible to abstract or present information in a more simple form but the reverse is never simple, or even possible. A metadata example of this situation is as follows:

  > Metadata is required by a local authority to meet an internal business need for data management of datasets to be used primarily by the local authority's database administrator. However, metadata for the same information resource has been requested by a regional forum of GIS officers from various local authorities to promote data sharing and joint spatial data maintenance between the different local authorities. In this situation it would be most appropriate to document to a metadata profile of Level 5 - Data Management. The metadata can then be made internally available at Level 5 and then reported to a Level 4 – Data Sharing profile for the Regional Forum as their requirement is less involved. If documentation was only for a Level 4 Metadata Profile it could not be reported within a Level 5 inventory.

- Once a decision on the metadata profile is reached, staff involved in the metadata implementation should become familiar with the reference documents available on the Environmental Reporting website, www.environment.govt.nz. These reference documents will provide detailed information on the metadata elements within the profile, including the UML modelling and XML schemas defining in detail each profile.

2.1 Deciding the Business Purpose

The creation of metadata requires significant time, effort and resource. This effort should be motivated by the desire to satisfy a clear business need. It should not be done just for the sake of metadata as it is expected that the metadata will be a resource that will require long-term support and maintenance from an agency to realise it's value. The business driver may be a requirement from another agency that is promoting information discovery and sharing or, more importantly, from an

internal organisational need to educate and inform staff of the availability of datasets that are useful to them in their regular work activities.

Whatever the need may be, this understanding helps in determining the amount of metadata needed to adequately meet that business need. The business needs will be varied. The Environmental Metadata Framework has defined a series of key business purposes to highlight why each group or agency needs metadata. These are defined in Table 1 below.

Table 1: Business Purposes

Business Purposes	Explanation
1. Data Discovery	The business driver of Data Discovery enables agencies to know about and publicise their existing data and information holdings. Discovery level metadata needs to provide the minimum amount of information required to convey the nature and content of the data resource to the potential user.
2. Data Fitness for Purpose	This business need is similar to the Data Discovery in that the agency wants to publicise their existing data and information holdings. In addition, there is a realization that this data will not suit all uses and the potential user must be aware of certain characteristics of the data to make an informed decision on whether it is appropriate for the planned use. This could include whether it is in the right place (has the right coverage), is at the right scale, is up to the required quality standard, or includes the necessary feature types. The benefits of this range from reducing download time to saving a project from failure due to the combining of incompatible datasets.
3. Data Use	In this situation an organization is publishing or distributing a new or revised information resource in digital formats to meet a specific purpose. Previously, the hardcopy published map included a range of details from the formal title, scale, publishing organization contact details, age of source material, Crown Copyright note and the legend. Metadata is the vehicle for all those details in the digital age.
4. Data Sharing	Data sharing is an extension of Data Use in that a new or revised information resource is being distributed in digital formats. However, in this situation, it is known from the outset that the information resource will be used to meet several purposes. A single purpose or type of use cannot be assumed (as can be the case with Data Use). Therefore assumptions need to be more clearly stated to guard against inappropriate use of the information resource. Likewise knowledge of the content of the dataset is more critical and the range of feature types included in a dataset need to be identified and defined in a way that encourages multiple use and data sharing.
5. Data Management	Where an organization has an on-going data management responsibility for a dataset there is an increased need for a higher level of documentation to guard against a major system failure. That system failure could come about from the loss of a key staff member who held knowledge critical to the management of the dataset in their heads. In some situations there is a need to maintain an audit trail of changes to a dataset – metadata provides a mechanism to make that audit trail.

To prompt your thinking, here are some questions to consider when deciding the business purpose:

- Who or what is driving the documentation of metadata?
- Is it an internal or external driver, or both?

2.2 Determining the Target Audience

Defining the target audiences (i.e. who will have access to and use of the metadata) follows on from defining the business driver. Identification of the target audience needs to consider not just the current situation but also the immediate future. In the future the implementation of new technology involving web-based environmental applications will significantly increase the number and range of people accessing environmental information. The concept of an information portal similar to the e-government's NZGO portal is being worked on for the environmental sector.

Three categories of target audience have been identified and are explained in Table 2 below.

Table 2: Target Audiences

Target Audiences	**Explanation**
1. Viewers of environmental information	Viewers are general browsers of information resources such as those searching a library catalogue looking for resources. Their interest is limited to knowing that a resource exists, and they may or may not want to assess it to decide whether to use it at a later date. The numbers of viewers could be in the range of thousands of individuals.
2. Users of environmental information	Users are individuals that may browse for information initially and then wish to make use of the information resource for analysis or reporting. They may like to know what sort of confidence they should have in the quality the information resource and have some information about what its spatial coverage may be. An example is a scientist developing a paper who needs to use information from a number of sources to analyse and reach a conclusion. The number of users of environmental information resources could be in the range of hundreds to thousands.
3. Doers who collect, develop and maintain environmental information	This level of audience includes the technical experts who may like to know if there are other individuals or groups that are collecting information in the same area of interest. They may want to access and alter data to meet their needs and will have an active role in managing the data in the short and long term. The number of those dealing with environmental information at this level could be in the range of tens to hundreds.

Some questions to consider when deciding the main Target Audience:

- Who do I expect will be accessing and using the metadata?

- Will these people view, use or be involved in the collecting, maintenance and management of the datasets?
- Realistically, what is the likely number of people using the metadata?

2.3 Choosing the Metadata Profile

The selection of metadata profile appropriate for a particular situation is relatively simple and uses the previous decisions made about the business purpose and target audience.

1. Verify the target audience is compatible with the decision on business purpose.

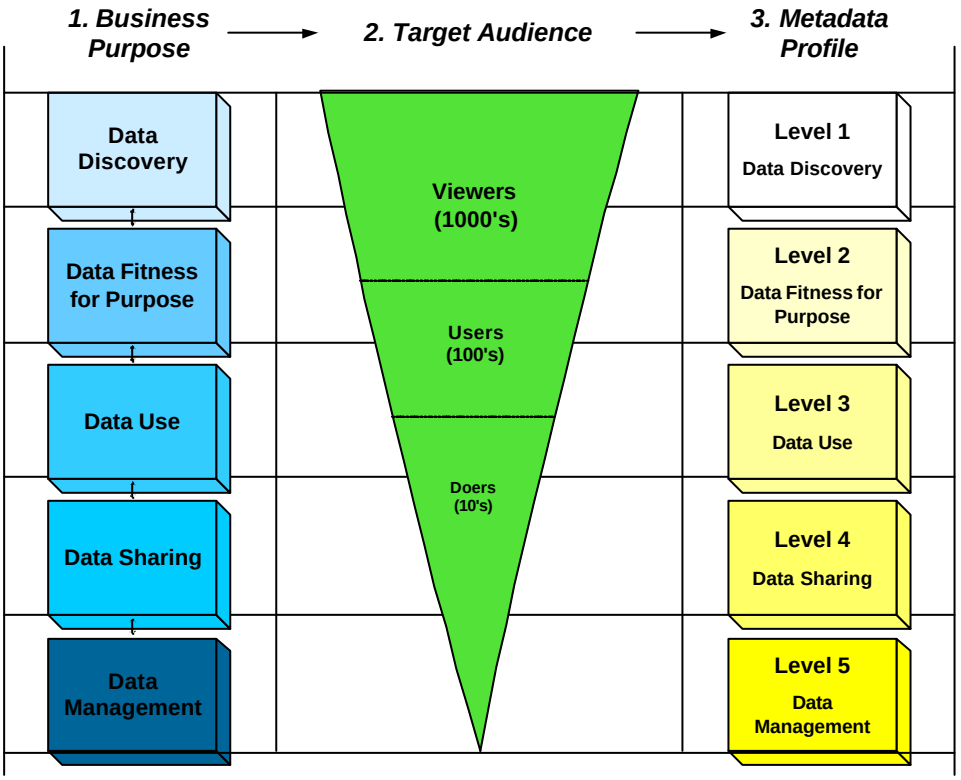
2. If the target audience is compatible with the business purpose, then the metadata profile is as shown in the figure below.

3. If the target audience is NOT compatible with the business purpose, re-examine the decisions on the business purpose and target audience in light of the organisation's mission statement, statutory obligations (eg Resource Management Act) and memorandum of understandings or other commitments between the organisation and other agencies.

4. In the unusual situation where it is not possible to resolve the apparent incompatibility, take the business purpose as paramount and select the corresponding metadata profile.

Figure 2 below presents the combined decisions on business purpose, target audience and the corresponding metadata profile.

Figure 2: Process for Selection of Metadata Profile



A metadata profile is defined as a 'set of one or more base standards or subsets of base standards and, where applicable, the identification of chosen clauses, classes, options and parameters of those base standards that are necessary for accomplishing a particular function'[1].

The range of elements that could be used to describe the information resources can range from a small number to several hundred. The Environmental Metadata Framework is designed to target the most valid elements possible and to endeavour to limit the size of the task of documenting metadata. As a result we have defined five metadata profiles, which are modular so that as the profile level number increases, more metadata elements are added to the profile. Within each profile the metadata elements are also assigned a condition of use of *mandatory* or *conditional*. This is part of the metadata standards and helps to make the standard extensible. Table 3 shows each metadata profile with a brief explanation of the approach. Refer to Appendix A for the matrix table, which displays the defined metadata profiles in more detail with the individual metadata elements.

Table 3: Environmental Metadata Framework Metadata Profiles

Metadata Profiles	Definition of Profiles
Level 1 – Data Discovery	Summary descriptions of content and quality, as well as contact details that are required for inclusion in directory systems and off-line distribution as well as on-line references (URL) for on-line viewing.
Level 2 – Data Fitness for Purpose	More comprehensive details on the use, limitations, data formats, imagery datasets transformation status, age of the data and vertical extents and data fees. These details provide potential users with some basis to assess its suitability for their purposes.
Level 3 – Data Use	More detailed information about data collection methods, integration and analysis techniques applied to create the dataset. As well, more complete citation and contact details. These details provide a benchmark of good practice for distributing new information resources in a digital, on-line environment.
Level 4 – Data Sharing	More detailed dataset content information (in the form of a Feature Catalogue) plus information about exchange format, compression and file system format that should accompany data transfers to other organizations.
Level 5 – Data Management	Even more detailed contents information (in the form of an Application Schema) plus documentation of the data quality regime for the dataset including quality test results. These details are considered critical for effective management of data resources both within data custodian organizations and where data exchanges between organizations occur.

2.4 Metadata Element Modules

Each of the five metadata profiles defined within the Environmental Metadata Framework are made up of element modules and sub-modules that are groups of metadata elements that are related or describe similar characteristics. The purpose of the element modules is to simplify the number of UML Classes that ISO19115 uses to group the metadata elements. This is to assist you through the learning process

[1] ISO/DIS 19106 Geographic Information Standard - Profiles

of how to interpret the modelling of ISO19115 using UML. Appendix B provides a view on the relationship between the element modules and the UML packages. Below each of the modules and sub-modules are described in general terms.

Metadata Identification Module

This module unambiguously identifies the actual metadata, defines the language and character set used (which may be apparent through the encoding process), cross-references the metadata to any earlier metadata, identifies those responsible for the producing the metadata and notes any ISO 19115 profile to which it conforms. These elements are important for the long-term maintenance of the metadata inventory.

Resource Identification Module

The Environmental Metadata Framework only expects to cover metadata for datasets or dataset series and services where government agencies have a requirement to provide NZGLS metadata for services provided. For this reasons many of the elements within this module directly correspond to both NZGLS and ISO 19115 core metadata elements.

This module includes similar details to the Metadata Identification Module plus an abstract and details on the purpose, mandate, and indication of the spatial resolution of the dataset, whether the dataset is vector or imagery based, topic category, Environmental Performance Indicators strand and a series of keywords based on NZGLS and ANZLIC thesaurus. Distribution (including Distributor) details are also outlined (using the Responsible Party sub-module).

Spatial and Extents Module

The Spatial and Extent module describes the geographic, temporal (when the data was captured/collected) and vertical extents. The geographic extents allow the extents to be described in terms of a geographic identifier (i.e. the NZGLS Coverage element), a geographic box where the extents are defined, or a custom defined polygon.

This module includes a reference to the spatial referencing system of the dataset, which is defined in more detail in Section 3. Other details in this module include those specific to remote sensed or scanned imagery and in particular points used or useful to any transformation process these images may have been subject to. There is also an element to describe the level of topological complexity inherent in any vector-based data.

Data Quality Module

The Data Quality module describes the overview statement of the general lineage of the dataset, plus a more detailed description of every process step and data source used in the creation of the dataset (for Level 3 – 5 Metadata Profiles). With the Data Management Metadata Profile, a description of a comprehensive quality regime is expected including descriptions of every relevant quality element with quality targets, evaluation methods and results achieved.

Data Characteristics Module

The Data Characteristics module describes any use limitations in addition to any other restraints that might apply to the dataset (including Crown Copyright notice if applicable). It also describes the formats the data is held in (as opposed to distribution formats), any known uses and details of the maintenance details for this dataset. In the more comprehensive Data Sharing (Level 4) and Data Management (Level 5) metadata profiles, this module includes the more detailed descriptions of the contents of the dataset through the creation of feature catalogue and/or application schema to accompany the metadata.

Citation and Responsible Party Sub-modules

These modules are repeated a number of times within each metadata profiles albeit that different levels of detail and are required in different circumstances.

The Responsible Party sub-module identifies as a minimum, the organisation, the position and the role the organisation is performing. In addition, it can also include contact details (email, physical address, phone, fax, URL).

The Citation sub-module is often used in conjunction with the Responsible Party sub-module. It takes the conventional use of citation for a published work and extends it to refer to other resources such as services. The title, alternative title, edition, and a special date type element that incorporates date with a particular action (creation, revision, publish) are also described.

2.5 Verifying the Selected Metadata Profile

It is important to remember that the Environmental Metadata Framework provides guidance for the decision making process. For this reason, once a profile has been identified it is important to verify that the profile will meet the specific project needs that may be the current driver for metadata documentation within an agency. This may be particular to an information sharing project or a community of interest wishing to know what information they may hold to build up an inventory specifically for their area of interest.

If a metadata profile is being developed for a specific project need e.g. Hydrological Society Sustainable Management Fund Project (Water Resources Inventory), it is important to include the dataset experts in the verification process. Running a workshop is one method of incorporating data experts for each dataset of interest to the project. The workshop would work through the decisions on business purpose and target audience; describe the content of each of the metadata profiles and how each profile differs; and then work through questions such as the ones below.

The questions below do not form a comprehensive list but have been developed to act as a prompt during the verification process and to encourage thinking about the issues from a variety of angles.

- Will this metadata profile enable the target audience to find all of the required information about the dataset?
- Does the profile provide enough detail about the information resource to ensure the knowledge of the dataset is available in the medium to long term?
- Is it realistic that all of the mandatory elements of the profile will be completed or will there be gaps? Has the knowledge of the dataset already been lost?
- Will the target audience get information overload, do they need to know all of this information if they are only interested in browsing?
- Where will this metadata be stored and who will be allowed to search it? (Content issues. Could some of the content be commercially sensitive?)
- Do any of the individuals/projects/organisations who will access the metadata have any specific requirements? Is it some/all or more what is being documented?
- Is a staged approach to documenting metadata needed? From a cost/benefit perspective is it appropriate to start with a Discovery profile and as time and resources are available drill down further with the documentation of metadata or is the risk too high that the knowledge will be lost?

- Will the target audience want to find individual data attributes or would they really only need to know about a dataset series e.g. Aerial photo series (Waikato Regional Aerial Photography Syndicate (WRAPS 1993) Flight Series) or Photo # of the 1993 Flight Series?

If you have any concerns, try another metadata profile and see whether that resolves those concerns. If your concerns persist, identify the additional metadata elements required to satisfy these concerns. Get a copy of the latest version of ISO 19115 and see whether the additional elements are described in ISO 19115. If they are, carefully record the details of these elements.

If ISO 19115 does not include the required additional elements, carefully define the nature of the new metadata elements you need, preferably in terms of the current definition of the metadata profile that most closely meets your needs. These metadata extension element definitions should conform to how ISO 19115 specifies extensions should be defined. An example of metadata extension for the Environmental Performance Indicators for use within the Environmental Metadata Framework is included in the reference material.

In both situations where the metadata profiles are added to, you will need to initiate the changes to your metadata application to accommodate these extra elements. This may only require minor changes to the schema defining your metadata profile.

2.6 Metadata Profile Customisation

Customisation of metadata profiles is possible but should not be undertaken without considering the impact, particularly on other potential uses of the metadata. There is also a significant risk that customisation will impair interoperability with other portals or inventories.

For example, an organisation creating metadata for internal data management purposes may make a number of changes and drop many of the Data Discovery metadata elements as being irrelevant to their organisational needs. That organisation is subsequently required to make the metadata available to a national portal such as the NZGO government portal, which is a Data Discovery portal, and finds that their metadata is missing critical fields for this other use of metadata.

Changes to the Metadata Profiles that can be accommodated:

1. Alteration of a metadata elements obligation status. In the more detailed descriptions of the metadata profiles (see appropriate reference material), you will note that each metadata element has an obligation status of *mandatory* or *conditional*. In the base standards (ISO 19115 & NZGLS) the obligation status of *optional* and *recommended* are also used. The only change that should be made to the obligation status is:

    - Defining a stronger obligation status (for instance, where all spatial datasets within an organization are all vector based and there are no imagery datasets and the metadata elements currently noted as conditional on the spatial dataset being vector based, the obligation status could be changed to mandatory).

2. Addition of extra metadata elements that are included in ISO 19115 (Geographic Information – Metadata) but not the metadata profiles. If additional elements are identified and they are defined in ISO19115 Metadata Standard, these can relatively simply be added to the customized metadata profile for that agency.

3. Addition of extra metadata elements that are NOT included in (ISO 19115 Geographic Information – Metadata) OR the metadata profiles. In this situation, if additional elements are identified special metadata extension element will also need to be created to define each new metadata element in addition to creating the new metadata element. The format of the metadata extension element is defined in ISO19115.

The implication of making any of these customisations to the metadata profiles is that it is likely that your database administrator or software developers will need to make changes to the application or XML files used to publish your metadata. These changes would need to reflect the changes or filter out (possibly by way of style sheets) the customisations made to the metadata profile when publishing the metadata outside of your organisation.

3. Spatial Referencing

This section is to provide guidance on how to complete the metadata to describe spatial extents. Spatial referencing is the term describing how the locational aspect of spatial data has been defined. The method used is similarly called the spatial referencing system. There are two categories of spatial referencing system:

- Coordinate spatial referencing systems – where spatial objects are spatially referenced by a series of coordinate values; and
- Static spatial referencing systems – where spatial objects are spatially referenced by reference to a pre-defined spatial object (e.g. a statistical mesh block).

Although the ideal situation is that all spatial data are described in terms of the same spatial referencing system, this is not practical in modern environmental information GIS applications. Fortunately, with modern GIS and the improved availability of authoritative definitions of key static datasets, it is possible to use environmental datasets with different spatial referencing systems in a single GIS application and to accurately overlay, view and analyse the data. However, this is not always the case and care needs to be taken to make sure only spatial data with compatible spatial referencing systems are used in environmental information applications.

Details on the spatial referencing system are included in the metadata so that potential users can ensure the spatial referencing system is compatible for their particular use.

3.1 Coordinate Spatial Referencing Systems

An organisation will need to define a standard coordinate spatial referencing system for spatial data collected and managed within the organisation. This system will be the organisation's base spatial referencing system.

The base spatial referencing system for all organisations aligned to the Environmental Metadata Framework should be one of the following:

- New Zealand Map Grid
- World Geodetic System 1984
- A coordinate system based on the New Zealand Geodetic Datum 2000 (NZGD2000)

In the future NZGD2000 based coordinate systems are expected to become the norm as most new spatial data is captured using this more modern geodetic datum.

Where a spatial dataset is not in terms with the organisation's base spatial referencing system, an assessment is required to determine whether the dataset's coordinate spatial referencing system is compatible with the base spatial referencing system.

The three characteristics that make coordinate spatial reference systems different and possibly incompatible are:

1. The Geodetic Datum used (the definition of the earth's curved surface)
2. The map projection used (and how that portrays bearings and distances)
3. The units of measurement (usually defined as part of the map projection)

For coordinate spatial referencing systems to be compatible, the Geodetic Datum should be the same and a map projection used that has been endorsed by an appropriate authority. The authoritative parameters defining both the Geodetic Datum and the map projection should be in the public domain.

One exception to this rule concerns World Geodetic System 1984 (WGS84) coordinates (latitude and longitude values with no map projection) and both map projections based on New Zealand Geodetic Datum 2000 (NZGD2000) as well as raw latitude and longitude values (no map projection). The two geodetic datum are different but these differences are very subtle and only relevant in precise geodetic applications.

In these instances (including the WGS84 exception), the only metadata element that needs to be described is an identifier for the spatial referencing system.

However, in other cases where there is different geodetic datum or the coordinate system is not widely used (i.e. is not mentioned in the following table) a more comprehensive metadata description is required. This metadata description will need to define the coordinate system or the mathematical transformation required to convert the spatial dataset into the organisation's base spatial referencing system. The full ISO 19115 metadata standard and ISO 19111 (Spatial Referencing by Coordinates) provide additional elements to make these descriptions.

3.2 Static Spatial Reference Systems

The requirement for an organisation using spatial information to define a base spatial referencing system remains when static spatial referencing occurs. The pre-defined spatial objects used to spatially reference other datasets must themselves be spatially referenced with a coordinate spatial referencing system compatible with the organisation's base spatial referencing system.

With datasets spatially referenced by way of static spatial reference systems, there are two metadata elements to be described:

1. The identifier for the spatial referencing system.

2. The inclusion in the data quality metadata elements (either lineage element or the data source element) of the details of the static spatial reference system including its coordinate spatial referencing system, where it was sourced from and when.

Some examples of static spatial referencing systems are identified in Table 4. Further details of other New Zealand static spatial referencing systems are included as Appendix C.

Table 4: New Zealand Static Spatial Referencing Systems

Code	**Full Name**	**Coordinate Spatial Referencing System**	**Authority**
BDEaddress	LINZ Address Points (supplied as part of BDE data deliveries)	NZGD2000	Land Information New Zealand
MeshBlock	Statistical Meshblock	NZGD2000	Statistics New Zealand
FMA	Fishing Management Areas	WGS84	Ministry of Fisheries

3.3 Determine Spatial Referencing System

In most organisations, the base spatial referencing system will be the New Zealand Map Grid, however, an increasing amount of spatial data supplied by Land Information New Zealand now uses spatial referencing systems based on NZ Geodetic Datum 2000.

Where there is the possibility of spatial datasets based on both NZ Geodetic Datum 1949 (NZMG) and NZ Geodetic Datum 2000, there are two issues that need to be resolved:

1. What is the current native spatial referencing system for your GIS? (or expressed differently, what is the spatial referencing system of the seed file of your GIS?)

   Check this on your GIS by opening a new file/table, create a new point feature and check how the coordinates of that feature are expressed – this will probably be the native spatial referencing system.

2. When does your organisation plan to make the transition to a NZ Geodetic Datum 2000 based spatial referencing system?

   If that transition has yet to occur, the metadata of any NZ Geodetic Datum 2000 datasets must refer to:

   - NZGD2000-based coordinate system as the dataset's spatial referencing system

     AND

   - The limitations of the built-in, on-the-fly, transformation provided by your GIS (the use limitation metadata element)

     OR

   - The transformation process (to NZMG) is described in the Data Quality lineage statement or Data Quality lineage process step (where the NZGD200 based data has been transformed to NZMG)

   If your organisation has already made the transition to a NZ Geodetic Datum 2000 based system record only the dataset's spatial referencing system (by using a code from the NZ_ReferenceSystems code list).

4. Describing the Contents of a Dataset

One of the fundamental requirements of metadata is to describe the contents of a dataset. With the Environmental Metadata Framework this is done differently depending on what Metadata Profile has been chosen.

All metadata profiles (Levels 1 – 5) describe the contents of the dataset in general terms in the abstract metadata element.

In addition to the abstract metadata element, the Data Sharing (Level 4) metadata profile requires a *feature catalogue* to be produced and be available to potential users. This feature catalogue should comply with ISO 19110 (geographic information standard for feature catalogues) and describe the feature catalogue, each *feature type*, each *feature attribute* and any *feature relationships*. The feature catalogue elements to be used in making these descriptions are described in the more detailed definition of the Data Sharing (Level 4) metadata profile (see the reference documents on www.environment.govt.nz). There are also two additional metadata elements required to cross reference the metadata to the feature catalogue.

The Data Management (Level 5) metadata profile also requires additional details to describe the contents of the dataset. In this case, the additional details take the form of the *application schema* describing the database where the data is maintained and managed. There are additional metadata elements to cross reference the metadata to the application schema and describe the type of application schema. However, the actual form of the application schema will depend on the host environment and what level of interaction is envisaged with other parties. ISO 19109 provides some guidance on application schemas for geographic information.

To summarise, this decision depends only on the metadata profile chosen.

1. If the Level 4 – Data Sharing metadata profile has been selected, prepare a feature catalogue (see Section 4). It should be noted that the same data encoding method should be used be used for the feature catalogue as for the metadata.

2. If the Level 5 – Data Management metadata profile has been selected, an application schema should be prepared in graphic form. The schema language used and the file describing the graphic form of the application schema will need to be referred to.

3. For all metadata profiles a high-level description of the data contents needs to be recorded in the abstract metadata element.

The creation of a feature catalogue or application schema is likely to highlight the need for documented organisational conventions. Before starting the process of collecting metadata and, preferably at the time of formulating an organisational metadata specification or standard, you should define the following:

- Namespace naming and structure
- Dataset File Naming
- Metadata, Feature Catalogue and Application Schema File Naming
- Organisation Naming
- Application of the Metadata Role Element
- How dates and periods of time are expressed

5. Identifying Key Quality Characteristics

It is only with the Data Management (Level 5) Metadata Profile that it is necessary to go beyond the overview quality descriptions of the metadata elements. Preparing a quality report for metadata purposes will require a significant initial input from people expert in the dataset to establish a comprehensive data quality regime. It will then require both an ongoing maintenance effort and an on-going testing effort. The results of that testing will also increase the metadata maintenance effort as the results of the testing are recorded.

Therefore, the key questions that need to be asked are:

- Do you have the resources (expert staff and budget) to establish a quality regime?
- Do you have the resources (staff and budget) to maintain a quality regime, including the conduct of data improvement initiatives and on-going maintenance of both the data resource and the metadata?

On the positive side, a comprehensive data quality regime with the results accessible through the metadata will provide the ultimate fitness for purpose details and provide better focus in data maintenance effort and data improvement initiatives.

In order to prepare the data quality component of a Data Management Metadata Profile other standards need to be consulted; notably:

- ISO/FDIS 19113 (Geographic Information - Quality principles)
- ISO/DIS 19114 (Geographic Information - Quality evaluation procedures)
- AS 1199–88 (Sampling Procedures and Tables for Inspection by Attributes) – endorsed by New Zealand Standards

The following process is based on these standards and involves the following tasks:[2]

Assess the relevant data quality elements

The first step is to review each of the 15 Data Quality sub-elements (identified in ISO/FDIS 19113) and decide which are relevant for the dataset for which you are preparing metadata. Although there are 15 sub-elements, many may not be relevant to the particular dataset. For instance, gridded data positional accuracy is not relevant in a purely vector-based dataset. This relevance test should also be widened to consider the likely impact of a data quality failure for a sub-element as well as the amount of effort required to test for the sub-element.

Table 5: Geographic Information Quality Elements and sub-elements

Data Quality Element	Data Quality sub-element	Data Quality sub-element described
Completeness	commission	Excess data present in a dataset.
	omission	Data absent from a dataset.
Logical consistency	conceptual consistency	Adherence to rules of the conceptual schema.
	domain consistency	Adherence of values to the value domains.

[2] The ESA Core Data Specification contains an illustration of this process including the determination of sample sizes for spatial datasets

Data Quality Element	Data Quality sub-element	Data Quality sub-element described
	format consistency	Degree to which data is stored in accordance with the physical structure of the dataset.
	topological consistency	Correctness of the explicitly encoded topological characteristics of a dataset.
Positional accuracy	absolute or external accuracy	Closeness of reported coordinate values to values accepted as or being true.
	gridded data positional accuracy	Closeness of gridded data position values to values accepted as or being true.
	relative or internal accuracy	Closeness of the relative positions of features in a dataset to their respective relative positions accepted as or being true.
Temporal accuracy	accuracy of a time measurement	Correctness of the temporal references of an item (reporting of error in time measurement).
	temporal consistency	Correctness of ordered events or sequences, if reported.
	temporal validity	Validity of data with respect to time.
Thematic accuracy	classification correctness	Comparison of the classes assigned to features or their attributes to a universe of discourse (e.g. ground truth or reference dataset).
	non-quantitative attribute correctness	Correctness of non-quantitative attributes.
	quantitative attribute accuracy	Accuracy of quantitative attributes.

The conclusions reached after this assessment is made may be that only a couple of Data Quality sub-elements are relevant. The next table illustrates a typical relevance assessment for a dataset.

Table 6: A Typical Quality Reference Assessment

Data Quality Element	Data Quality sub-element	Rationale
Completeness	commission	Relevant – duplicated features with potentially different attributes would undermine proposed application.
	omission	Irrelevant – dataset is sufficiently close to the total population not to seriously impact on proposed application.
Logical consistency	conceptual consistency	Irrelevant – dataset is based on a simple data model with few relationships.
	domain consistency	Relevant – easy to test whole dataset with simple software routine.

Data Quality Element	Data Quality sub-element	Rationale
	format consistency	Relevant – easy to test whole dataset with simple software routine.
	topological consistency	Irrelevant – proposed application does not rely on topology.
Positional accuracy	absolute or external accuracy	Relevant – proposed application involves the spatial overly of several datasets that have been captured/collected separately.
	gridded data positional accuracy	Irrelevant – only vector spatial data.
	relative or internal accuracy	Irrelevant – disparate datasets involved in proposed application, will rely on absolute accuracy.
Temporal accuracy	accuracy of a time measurement	Irrelevant – dates of capture/collection well established.
	temporal consistency	Irrelevant – not relevant to proposed analysis.
	temporal validity	Irrelevant – data capture/collection is sufficiently recent so no doubts about the validity.
Thematic accuracy	classification correctness	Irrelevant – any errors in feature classification will either be extremely obvious or have no impact on the proposed analysis.
	non-quantitative attribute correctness	Irrelevant – too expensive to consider tests and errors would have little impact on proposed application.
	quantitative attribute accuracy	Irrelevant (initially). Eventually should consider establishing a separate process to test random selected samples. In short term, impact of errors is low for initial application but could impact significantly on extensions to the proposed application.

Determine acceptable quality levels

Once the relevant Data Quality sub-elements have been identified, acceptable quality levels (AQL) for each of the relevant sub-elements must be determined. In making this decision, consideration should be given to future as well as current uses of the dataset. Where possible, AQL should be quantitative and expressed in statistical terms. Rather than expressions of better than 5 metres absolute accuracy, an expression of a root mean square error of no more than 1.5 metres would be more useful.

Design quality evaluations

For each relevant Data Quality sub-element and the corresponding AQL, an evaluation method needs to be designed. Selecting an appropriate sampling method in order to ensure the resulting quality regime does not become too expensive and onerous is particularly critical.

As is described in the standards mentioned earlier in this section, different sampling methods, including a combination of methods) can be applied to spatial datasets including:

- Randomly selected sample of an appropriate size selected from the total population (conventional sampling used with non-spatial applications)

- Randomly selected sample of an appropriate size from total population based on geographic coverage (eg. two randomly selected meshblocks out of a total coverage of 200 meshblocks)

- Randomly selected sample of an appropriate size from all instances of a particular feature type (eg. check the absolute accuracy of all road intersection features but do not check road segment or bridge features)

The determination of the sample size is critical if valid conclusions are to be reached about the whole of the dataset. AS 1199–88 (endorsed by Standards New Zealand) gives some valuable guidance on this issue although it does have a manufacturing focus and does not consider the special case of spatial datasets.

However, in some situations, sampling may not be appropriate, eg. if the whole dataset can be tested especially where the evaluation method can be applied as a software routine.

Another critical aspect of designing these quality evaluations is the timing of these evaluations.

The design of appropriate data quality evaluations is a crucial task and will require input from data users, database administrators, statistical experts and, most likely, software developers.

Document data quality regime as metadata

The Data Management (Level 5) metadata profile includes an additional Data Quality Report series of metadata elements to describe the data quality regime of a dataset for each relevant sub-element (DQ_Element). Any quantitative results from quality testing are appended to each sub-element as is a statement about whether the dataset currently conforms to the stated acceptable quality level.

As the metadata provides the quality audit trail of the dataset, it is very important for the metadata to be kept up to date.

6. Principles for Metadata Content

This section provides guidance for the completion of metdata that are common to all metadata profiles. Most of the definitions have come from the ISO19100 series of standards and are also detailed in the ISO19115 document. This is not a complete and comprehensive listing of principles and some may need to be developed at an organisational or community of interest level.

Namespace structure

Where metadata is published on-line by the Ministry, a namespace structure should be defined as the repository for geospatial metadata:

eg http://www.mfish.govt.nz/resources/data/metadata/geospatial/iso19115

Data file names

Where your organisation publishes data on-line or provides data to a user for off-line use, the data, the accompanying metadata and feature catalogue or application schema should be named in a consistent manner. Here is an example:

<fname>dat where <fname> describes the nature of the data – to be defined by the data steward. Although naming should be as descriptive as possible, all relevant details of the data should be included in the metadata descriptions	Characters 1 –7
A dataset identifier to be specified by data steward (at the time of initial distribution or when a data supply or maintenance contract is let)	Characters 8 – 12
A unique dataset identifier	Character 13 –16
v	Character 17
Version number in real number format. 0-n only to be used for preliminary data supplies. First initial official supply to be 1-0. New versions resulting from maintenance updates reflected by incrementing previous version by 0-1. Significant data improvements to dataset to be marked by a new whole number (eg 2-0). Where maintenance is a systematic process, the anniversary of the initial supply/compilation of the dataset should be marked with a new version identified with a new whole number.	Characters (18 – 21) (including dash to represent decimal point)

Metadata file names

And similarly, an example of metadata file naming:

<fname>meta – where <fname> is the same as the corresponding data file	Characters 1 -11
The same identifier as used for the data	Characters 12 – 16
v	Character 17
Version number in real number format. To coincide with the version number given to the data	Characters (18 – 21) (including decimal point)

Feature catalogue file names

And similarly, an example of feature catalogue file naming:

<fname>feat – where <fname> is the same as the corresponding data file	Characters 1 -11
The same identifier as used for the data	Characters 12 – 16
v	Character 17
Version number in real number format. To coincide with the version number given to the data	Characters (18 – 21) (including decimal point)

Application schema file names

And similarly, an example of an application schema file naming:

<fname>apsc – where <fname> is the same as the corresponding data file	Characters 1 -11
The same identifier as used for the data	Characters 12 – 16
v	Character 17
Version number in real number format. To coincide with the version number given to the data	Characters (18 – 21) (including decimal point)

Organisation name

Organisation names should be used in full and not abbreviated.

Role

The *Role* metadata element occurs in many different metadata components. It is essential that the correct and most appropriate role values are used.

Code Value	Description	Suggested Uses
001	ResourceProvider	Only as approved by authorised user of Ministry data
002	Custodian	eg. National Institute of Water and Atmospheric Research and other organisations who manage the data on behalf of the steward.
003	Owner	Government of New Zealand
004	User	Only duly authorised user of the data
005	Distributor	Only as designated by steward
006	Originator	Source of any constituent or derived component of a Ministry dataset series
007	PointOfContact	Only as designated by steward
008	PrincipalInvestigator	Only as designated by steward
009	Processor	Only as approved by authorised user of the data
010	Publisher	Only as approved by authorised user of the data
011	Steward	eg. Ministry of Fisheries

Date values

All date values should conform with ISO 8601 standard. That is:

A day YYYY-MM-DD eg. 2002-06-07

Period YYYY-MM-DD:YYYY-MM-DD eg. 2002-05-27:2002-06-07

7. Metadata Reference Documents

NZGLS

The New Zealand Government Locator Service (NZGLS) is a metadata standard for use by New Zealand government agencies that create or manage information resources or services that are locatable via the Internet.

Government agencies have been directed by Government to be NZGLS metadata compliant by 30 June 2002. An agency is considered to be NZGLS compliant when:

- Good quality NZGLS metadata has been created for all the resources described in the minimum set of resources
- The contents of the agency's entire website are described at an appropriate level of aggregation
- Archives New Zealand has certified the agency's compliance with the NZGLS standard

The minimum set of resources which require NZGLS metadata are:

1. Home pages
2. The agency's description of itself
3. High demand topics and services
4. Entitlements to government assistance or obligations
5. On-line services (and especially entry points to services such as library catalogues or legal databases)
6. Major formal publications
7. Major reports
8. Media releases
9. Major entry point for indexes and menus to closely related topics
10. Information about an agency which affects the public
11. Access for common business processes (but not agency specific functions)
12. Descriptive or marketing information
13. Contracted out services

The metadata profiles described in this framework conform to both ISO/DIS 19115 and NZGLS (Version 2). The Environmental Metadata Framework Reference Manual describes each metadata element contained in the metadata profiles and its corresponding NZGLS metadata element, where one exists.

ISO19115

ISO 19115 is the metadata standard in a series of over 30 geographic information standards[3] developed by a dedicated technical committee (TC211) of the International Organisation for Standardisation (ISO). The current (August 2002) status of ISO 19115 is Draft International Standard (DIS) and it is envisaged it will become a full International Standard in early 2003. Despite its current draft status, it is now in a very stable form and any changes made in its final stages are likely to be very minor.

The stated objective of ISO 19115 is:

> 'to provide a structure for describing digital geographic data. This International Standard is intended to be used by information system analysts, program planners, and developers of geographic information systems, as well as others in order to understand the basic principles and the overall requirements for standardization of geographic information. This International Standard defines metadata elements, provides a schema and establishes a common set of metadata terminology, definitions, and extension procedures.
>
> When implemented by a data producer, this International Standard will:
> 1) Provide data producers with appropriate information to characterize their geographic data properly.
> 2) Facilitate the organization and management of metadata for geographic data.
> 3) Enable users to apply geographic data in the most efficient way by knowing its basic characteristics.
> 4) Facilitate data discovery, retrieval and reuse. Users will be better able to locate, access, evaluate,
> 5) purchase and utilize geographic data.
> 6) Enable users to determine whether geographic data in a holding will be of use to them.
>
> This International Standard defines general-purpose metadata, in the field of geographic information. More detailed metadata for geographic datatypes and geographic services are defined in other ISO 19100 series standards and user extensions[4]'.

ANZLIC Metadata

In 1996, ANZLIC produced the first version of ANZLIC Metadata Guidelines: Core metadata elements for geographic data in Australia and New Zealand. These guidelines provided the first widely accepted structure for documenting metadata of resources such as data, information, publications and systems and formed the foundation for the development of the Australian Spatial Data Directory. It was also adopted by a number of New Zealand agencies who had begun the task of documenting metadata.

A second version of the ANZLIC metadata guidelines was produced in February 2001 and one of the changes was to align the guidelines more closely with ISO 19115. A third version is planned for 2002 that will complete this transition with the guidelines becoming a profile of ISO 19115.

As the later versions of the ANZLIC metadata guidelines have become more aligned with ISO 19115 their customisation for the specific requirements of geospatial information users in the New Zealand and Australia has been lost. The latest draft ANZLIC profile is aimed at geospatial data managers and software developers rather than producers and users of geographic information. As such the aim of this ANZLIC profile is to describe the structure required to contain all ISO 19115 mandatory elements rather than define New Zealand and Australia user requirements for metadata,a change in the ANZLIC focus that heightens the need for the development of what ISO 19115 calls community profiles such as this Environmental Metadata Framework.

[3] Bibliography references other ISO TC211 standards of potential interest to users of EMF

[4] From the Introduction to ISO 19115 DIS

8. Glossary

Term	Explanation
Accuracy	Closeness of agreement between a test result and the accepted reference value [ISO 19113]
ANZLIC	Australia New Zealand Land Information Council
Application schema	Conceptual schema of data required by one or more applications [ISO 19103]
AQL	Acceptable quality level [ISO 2859]
Association	The semantic relationship between two or more classifiers that involves connections between their instances [ISO 19103]
Attribute	The description of a named slot of a specified type in a class; each object of the class separately holds a value of the type [ISO 19103]
Business purpose	The organisational reason and rationale for undertaking some activity or assuming responsibility for a function.
CASE	Computer Aided Software Engineering
Class	Descriptor of a set of objects that share the same attributes, operations, methods, relationships and behaviour [ISO 19103]
Conformance	Fulfilment of specified requirements [ISO 19113]
Constraint	A semantic condition or restriction represented as an expression [ISO 19103]
Coordinate conversion	Change of coordinates, based on a one-to-one relationship, from one coordinate system to another based on the same datum [ISO 19111]
Coordinate transformation	Change of coordinates, based on a one-to-one relationship, from one coordinate system to another based on a different datum through a one to one relationship [ISO 19111]
Data quality measure	Type of test applied to the data specified by a data quality scope [ISO 19113]
Dataset	Identifiable collection of data [ISO 19113]
Dataset series	Collection of datasets sharing the same product specification [ISO 19113]
Datum	Parameter or set of parameters that may serve as a reference or basis for the calculation of other parameters [ISO 19111]
Direct evaluation method	Method of evaluating the quality of a dataset based on inspection of the items within the dataset [ISO 19114]
Domain	Well defined set of values
DTD	Document Type Declaration (within XML context)
Element	See Metadata element
Ellipsoid	Surface formed by the rotation of an ellipse about an axis [ISO 19111]
Encoding	Conversion of data into a series of codes [ISO 19118]
Feature	Abstraction of real world phenomena [ISO 19113]

Term	Explanation
Geodetic datum	Datum describing the relationship of a coordinate system to the Earth [ISO 19111]
GIS	Geographical Information System
GML	Geographic Markup Language (within XML context)
ICSM	Intergovernmental Committee on Surveying and Mapping
ISO	International Organisation for Standardisation
Instance	An individual entity with its own identity and value [ISO 19103]
Map projection	Coordinate conversion from a geodetic coordinate system to a plane [ISO 19111]
Metadata	Data about data [ISO 19115] Metadata
Metadata element	Discrete unit of metadata [ISO/DIS 19115]
Metadata Framework	A series of guidelines describing potential components required to define, describe, publish and maintain metadata .
Metadata module	A series of metadata elements describing similar characteristics
Metadata profile	An instance of a profile (as prescribed in ISO 19116) defining metadata requirements in terms of a metadata standard (eg ISO 19115) for a specific information community.
NZGLS	New Zealand Government Locator Service, a discovery level metadata service developed by the State Services Commission's E-Government Unit.
OCGI	Officials' Committee for Geospatial Information
OOM	Object Oriented Model
Open GIS Consortium (OGC)	OGC is an international industry consortium of more than 220 companies, government agencies and universities participating in a consensus process to develop publically available geoprocessing standards [www.opengis.org].
Package	A general-purpose mechanism for organising elements into groups [ISO 19103]
Population	Totality of items under consideration [ISO 3534-2:1993]
Profile	Set of one or more base standards or subsets of base standards, and, where applicable, the identification of chosen clauses, classes, options and parameters of those base standards, that are necessary for accomplishing a particular function [ISO 19106]
Quality	Totality of characteristics of a product that bear on its ability to satisfy stated and implied needs [ISO 19113]
Resource	Asset or means that fulfils a requirement [ISO/DIS 19115]
RMSE	Root mean square error (determined by calculating the deviations of points from their true position, summing up the measurements and then taking the square root of the sum)
Schema	Formal description of a model [ISO 19103]
Service	The variety of applications with different levels of functionality that facilitate access to and the use of geographic information [adapted from ISO 19119]

Term	Explanation
Target audience	The subject and target group for a particular service or message
Topology	Properties of spatial configuration invariant under continuous transformation [ISO 19103]
UML	Unified Modelling Language
Universe of discourse	View of the real or hypothetical world that includes everything of interest [ISO 19113]
XML	Extensible Markup Language
XSD	Extensible Schema Document (within XML context)

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Appendix A - Matrix of Metadata Profiles with Element Modules

Metadata Element	Level 1	Level 2	Level 3	Level 4	Level 5
MD_Metadata (1)					
.fileIdentifier (2)					
.language (3)					
characterSet (4)					
.parentIdentifier (5)					
.contact (8)					
.CI_RespParty (374)					
.pointOfContact (29)					
.organisationName (376)					
.positionName (377)					
.contactInfo (387)					
CI_Contactaddress (389)					
EMailAddress(386)					
role (379)					
.dateStamp (9)					
.metadataStandardName (10)					
.metadataStandardVersion (11)					
MD_SpatialRepresentation (12/156)					
.MD_VectorSpatialRepresentation (176)					
.topologyLevel (177)					
.MD_GridSpatialRepresentation (157)					
.numberOfDimensions (158)					
.axisDimensionsProperties (159)					
.dimensionName (180)					
.dimensionSize (181)					
.dimensionName (180)					
.dimensionSize (181)					
.cellGeometry (160)					
.transformationParameterAvailability (161)					
MD_Georectified (162)					
.checkPointAvailability (163)					
.checkPointDescription (164)					
.cornerPoints (165)					
.diagonal1NorthEndNorthing					
.diagonal1NorthEndEasting					
.diagonal1SouthEndNorthing					
.diagonal1SouthEndEasting					
.diagonal2NorthEndNorthing					
.diagonal2NorthEndEasting					
.diagonal2SouthEndNorthing					
.diagonal2SouthEndEasting					
.pointInPixel (167)					
.transformationDimensionDescription (168)					
.transformationDimensionMapping (169)					
MD_Georeferencable (707)					
.controlPointAvailability (171)					
.orientationParameterAvailability (172)					
.parameters (174)					
MD_ReferenceSystem (13/186)					
.referenceSystemIdentifier (187)					
.code (207)					
MD_Identification (15/23)					
citation (24)					
Title (360)					
.alternateTitle (361)					
.date (362/394)					
.edition (363)					
.editionDate (364)					
.identifier (365)					
.presentationForm (368)					
.ISBN (372)					

Metadata Element	Level 1	Level 2	Level 3	Level 4	Level 5
.ISSN (373)					
.abstract (25)					
.purpose (26)					
.audience					
.New Zealand mandate					
.status (28)					
.pointOfContact (29/374)					
.organisationName (376)					
.positionName (377)					
.contactInfo (387)					
CI_Contactphone (388)					
Voice(408)					
Facsimile(409)					
CI_Contactaddress (389)					
DeliveryPoint(381)					
City(382)					
Country(385)					
EMailAddress(386)					
CI_OnlineResource(390)					
.linkage (397)					
role (379)					
MD_MaintenanceInformation (30/142)					
.maintenanceAndUpdateFrequency (143)					
.dateOfNextMaintenance (144)					
.maintenanceNote (148)					
resourceFormat (32/284)					
.name (285)					
.version (286)					
.DescriptiveKeywords (33)					
.keyword (53) [NZGLS Subject]					
.type (54)					
.thesaurusName (55) [FONZ, SONZ or ANZLIC]					
MD_Usage (34/62)					
. .specificUsage (63)					
.userDeterminedLimitations (65)					
.userContactInfo (66)					
.CI_RespParty(374)					
.pointOfContact (29)					
.organisationName (376)					
.positionName (377)					
.contactInfo (387)					
CI_Contactaddress (389)					
EMailAddress(386)					
role (379)					
MD_Constraints (35/67)					
.useLimitation (68)					
MD_LegalConstraints (69)					
.accessConstraints (70)					
.useConstraints (71)					
.otherConstraints (72)					
MD_DataIdentification (36)					
.spatialRepresentationType (37)					
spatialResolution (38)					
equivalentScale (60)					
.distance (61)					
language (39)					
characterSet (40)					
topicCategory (41)					
MfE EPI Strand					
.extent (45)					
.geographicElement (336)					
.extentTypeCode (340)					
.geographicBox (42/343)					
.westBoundLongitude(344)					
.eastBoundLongitude(345)					
.southBoundLatitude(346)					
.northBoundLatitude(347)					

Metadata Element	Level 1	Level 2	Level 3	Level 4	Level 5
.geographicIdentifier (349)					
.polygon (342)					
.temporalElement (337)					
.extent (351)					
.verticalElement (338)					
.minimumValue (355)					
.maximumValue (356)					
.unitOfMeasure (357)					
.verticalDatum (358)					
MD_ContentInformation (16/234)					
MD_FeatureCatalogueDescription (235)					
.includedWithDataset (238)					
.featureCatalogueCitation (240)					
.title (360)					
.date (362)					
.edition (363)					
MD_Distribution (17/270)					
distributionFormat (271)					
name (285)					
version (286)					
.distributor (272)					
.distributorContact 280)					
.organisationName (376)					
.positionName (377)					
.contactInfo (387)					
.phone (388)					
. voice (408)					
.facsimile (409)					
.address (389)					
DeliveryPoint(381)					
City(382)					
Country(385)					
EMailAddress(386)					
.online (277)					
.linkage(397)					
role (379)					
.distributionOrderProcess (281/296)					
.fees (299)					
.orderingInstruction (301)					
.turnaround (302)					
.MD_DigitalTransferOptions (273)					
.unitsOfDistribution (275)					
.transferSize (276)					
.online (277)					
.linkage(397)					
.protocol (398)					
.name (400)					
.description (401)					
.function (402)					
.offline (278/291)					
.name (292)					
.mediumFormat (296)					
.mediumNote (297)					
.dataQualityInfo (18)					
Scope (79)					
.level (139)					
.report (80)					
DQ_Element (101)					
.nameOfMeasure (100)					
.measureIdentification (99)					
.authority (206)					
.organisationName (376)					
.positionName (377)					
.role (379)					
.code (207)					
.measureDescription (102)					
.evaluationMethodType (103)					

Metadata Element	Level 1	Level 2	Level 3	Level 4	Level 5
.evaluationMethodDescription (104)					
.dateTime (106)					
.result (107/128)					
DQ_ConformanceResult (129)					
.specification (130)					
.title (360)					
.date (362)					
.explanation (131)					
.pass (132)					
DQ_QuantitativeResult (133)					
.valueUnit (135)					
.value (137)					
.lineage (81/82)					
.statement (83)					
.processStep (84)					
.description (87)					
.rationale (88)					
.dateTime (89)					
.processor (91)					
.organisationName (376)					
.role (379)					
.source (85)					
.scaleDenominator (94)					
.sourceReferenceSystem (95)					
. referenceSystemIdentifier (187)					
.code (207)					
.sourceCitation (96)					
.title (360)					
.date (362)					
.edition (363)					
.citedResponsibleParty (367)					
.organisationName (376)					
.role (379)					
.sourceExtent (97)					
.geographicIdentifier (349)					
MD_ApplicationSchemaInformation (21/322)					
.name (321)					
Title (360)					
.date (362)					
.edition (363)					
.citedResponsibleParty (367/374)					
.organisationName (376)					
.positionName (377)					
role (379)					
.schemaLanguage (322)					
..graphicsFile (325)					

Metadata element module	Key
Metadata identification	
Resource identification	
Spatial and extents	
Data quality	
Data characteristics	

The Citation & Responsible Parties sub-module is included within the appropriate element module.

UML Diagram	Data Dictionary	ISO Packages	UML Class	Condition	Entity		
A.2.1	B.2.1	Metadata Entity Set Information	MD_Metadata	M	MD_Identification		
					MD_Constraints		
					DQ_DataQuality		
					MD_MaintenanceInformation		
					MD_SpatialRepresentation		
					MD_ReferenceSystem		
					MD_ContentInformation		
					MD_PortrayalCatalogueReference		
					MD_Distribution		
					MD_MetadataExtensionInformation		
					MD_ApplicationSchemaInformation		
					CI_ResponsibleParty		
A.2.2	*B.2.2*	Identification Information	MD_Identification *MD_DataIdentification* *MD_ServiceIdentification*	M	MD_Format		
					MD_BrowseGraphic		
					MD_Usage		
					MD_Constraints		
					MD_Keywords		
					MD_MaintenanceInformation		
					CI_ResponsibleParty		
A.2.3	*B.2.3*	Constraint Information	MD_Constraints	O	MD_LegalConstraints		
					MD_SecurityConstraints		
					DQ_Scope	EX_Extent	
						MD_ScopeDescripti	
					LI_Lineage	LI_ProcessStep	
						LI_Source	
					DQ_Element	DQ_Completeness	
						DQ_LogicalConsiste	
						DQ_PositionalAccur	
						DQ_ThematicAccura	
						DQ_TemporalAccur	
A.2.5	*B.2.5*	Maintenance	MD_MaintenanceInformati	O	MD_MaintenanceInformation	MD_ScopeDescripti	

					MD_VectorSpatialRepresentation	MD_GeometricObje	
A.2.7	*B.2.7*	Reference System Information	MD_ReferenceSystem	O	MD_Identifier	CI_Citation	
					MD_CRS	MD_ProjectionPara	
						MD_EllipsoidParam	
A.2.8	*B.2.8*	Content Information	MD_ContentInformation	O	MD_FeatureCatalogueDescription	CI_Citation	
					MD_CoverageDescription	MD_RangeDimensi	
						MD_ImageDescripti	
A.2.9	*B.2.9*	Portrayal Catalogue Information	MD_PortrayalCatalogueReference	O	MD_PortrayalCatalogueReference	CI_Citation	
A.2.10	*B.2.10*	Distribution Information	MD_Distribution	O	MD_DigitalTransferOptions	MD_Medium	
						CI_OnlineResource	
					MD_Distributor	MD_StandardOrderF	
						CI_ResponsibleParty	
					MD_Format		
A.2.11	*B.2.11*	Metadata Extension Information	MD_ExtensionInformation	O	MD_ExtensionInformation	CI_OnlineResource	
						MD_ExtendedElem mation	
A.2.12	*B.2.12*	Application Schema Information	MD_ApplicationSchemaInformation	O	MD_ApplicationSchemaInformation	MD_SpatialAttribute ment	
A.3.1	B.3.1	Extent Information	EX_Extent	O	EX_GeographicExtent	EX_BoundingPolyg	
						EX_GeographicBou ox	
						EX_GeographicDes	
						EX_SpatialTempora	
					EX_TemporalExtent	EX_SpatialTempora	
					EX_VerticalExtent	SC_VerticalDatum	
A.3.2	B.3.2	Citation & Responsible Party Information	CI_Citation		CI_ResponsibleParty		
					CI_Date		
			CI_ResponsibleParty		CI_Contact	CI_Telephone	
						CI_Address	
						CI_OnlineResource	

Note: A number of the ISO 19115 Entities are part of optional and/or repeated structures.

Metadata element module	**Key**
Metadata identification	
Resource identification	
Spatial and extents	
Data quality	
Data characteristics	
Citation & esponsible parties sub-module	

Appendix C New Zealand Static Spatial Referencing Systems

Code	Full Name	Geodetic Datum	Authority
NZMG	New Zealand Map Grid	New Zealand Geodetic Datum 1949	Land Information New Zealand
WGS84	World Geodetic System 1984 (no map projection)	WGS84	(United States) National Imagery and Mapping Agency
NZGD2000	Unprojected New Zealand Geodetic Datum 2000 (no map projection)	New Zealand Geodetic Datum 2000	Land Information New Zealand
AMURI2000	Amuri 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
BAYoFPLENTY2000	Bay of Plenty 2000	New Zealand Geodetic Datum 2000	Land Information New Zealand
BLUFF2000	Bluff 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
BULLER2000	Buller 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
COLLINGWOOD2000	Collingwood 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
GAWLER2000	Gawler 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
GREY2000	Grey 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
HAWKESBAY2000	Hawkes Bay 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
HOKITIKA2000	Hokitika 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
JACKSONSBAY2000	Jacksons Bay 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
GREY2000	Grey 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
KARAMEA2000	Karamea 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand

LINDISPEAK2000	Lindis Peak 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
MARLBOROUGH2000	Marlborough 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
MtEDEN2000	Mt Eden 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
MtNICHOLAS2000	Mt Nicholas 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
MtPLEASANT2000	Mt Pleasant 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
MtYORK2000	Mt York 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
NELSON2000	Nelson 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
NORTHTAIERI2000	North Taieri 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
OBSERVATIONPt2000	Observation Point 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
OKARITO2000	Okarito 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
POVERTYBAY2000	Poverty Bay 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
TARANAKI2000	Taranaki 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
TIMARU2000	Timaru 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
TUHIRANGI2000	Tuhirangi 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
WAIRARAPA2000	Wairarapa 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
WANGANUI2000	Wanganui 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand
WELLINGTON2000	Wellington 2000 Meridional Circuit	New Zealand Geodetic Datum 2000	Land Information New Zealand